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Black Bear Behavior and Human-Bear Relationships in  
Yosemite National Park

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SUMMARY OF  
BLACK BEAR BEHAVIOR  
AND  
HUMAN-BEAR RELATIONSHIPS  
IN  
YOSEMITE NATIONAL PARK,  
1978-1979



Photo by Jeff Keay

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## INTRODUCTION

National Park Service concern for escalating damage from bears initiated studies to reduce and hopefully eliminate the unnatural association between bears and humans. A review of published work and experience of managers suggested that the beginning of problems stems from changes in two behavioral processes in bears. First, protection from human harassment causes bears to lose their natural avoidance behavior of people. Often coupled with this process is a growing linkage between bears and people based on the ready availability of camper food. These food rewards also reduce avoidance behavior.

This simple model suggested studies were needed on two questions: How do we reduce contact between bears and people, and how can bears be prevented from obtaining food? Additional information of interest was the extent of present contact between bears and people. This would provide managers and administrators with a better understanding of the scope of the problem, particularly the potential for fear or injury to park visitors.

The two major problem areas to be studied, as stated in the research proposal (Gilbert and Hastings 1978, p.6), were "(1) human-bear interactions examined largely through observational and interviewing approaches and (2) aversive conditioning, studied experimentally." The latter furnished knowledge on both success and problems with the use of aversion in the field. The study of human-bear interactions provided a comprehensive source of information on what behavior people employed when confronted with bears. Identification of effective ways of reacting to bears can assist in reducing the amount of food that bears obtain from people. If Park Service educational materials incorporate advice on what behavior deters bears without jeopardizing safety, then rate of food reward for bears could be expected to decline and

bears would have to rely more on natural food. The latter is consistent with the goals of bear management in national parks as articulated by Martinka (1977).

The study was conducted in Yosemite National Park on the western slopes of the Sierra Nevada Mountains. This area was chosen due to the history of bear problems and the ability to mark individuals.

#### SUMMARY OF FINDINGS

##### Human-Bear Interactions

Employees of the National Park Service are often asked by the public what to do in "bear country." A study was conducted in Yosemite National Park in order to answer this question by quantitatively documenting interactions between black bears and backcountry visitors, and by identifying the factors affecting those encounters.

Nine hundred and ninety-two interactions were observed. The most common responses of visitors to bears were to watch, walk toward, and talk to others and/or point at the bear (Tables 1 and 2, Appendix). Bears responded to humans largely by walking away, watching, travelling around, walking toward, and running away from people (Tables 3 and 4).

Each behavior for both species was categorized into one of four response classes (Tables 5 and 6): (1) fear/avoidance, (2) neutrality, (3) approach, or (4) aggression. Over 65 percent of visitor responses were neutral (Tables 7 and 8). People were least likely to react to bears with fear/avoidance behavior.

Bears were also most likely to be neutral (Tables 9 and 10). Of particular interest is the low occurrence of aggression shown by bears. Less than two percent of all responses fell into this category, most of which were exhibited by two animals. We witnessed no interactions which resulted in

injury or any physical contact between visitors and bears. When ursid aggression did occur, it was correlated with the month of June, younger visitors, and close distances between the species. Both human aggression and fear were correlated with short interactions.

Two of the best techniques discovered for ridding a campsite of a black bear were to run toward it and to throw objects at it. However, reduction of distance between the two species was correlated with increased bear aggression. Other effective methods were to yell, clap hands, and bang pots together; combining these mildly aggressive acts seemed to be particularly effective in removing bears.

Bear behavior was greatly altered by possession of camper foods. Bears were more neutral and walked toward people less after they had begun to eat. They also showed much less fear of visitors at this time.

Other correlations of both human and ursid behavior with biotic and abiotic variables (temporal, spatial, environmental, etc.) are discussed further in L. Hastings' thesis. However, the most important aspects related to improved management are summarized above.

Certain qualitative information from researcher observations also appears relevant to bear management. Improper food storage was, of course, often related to unhappy and occasionally frightening interactions. Visitors often appeared to be completely ignorant of food storage techniques including the existence of food suspension cables provided by the Park Service. Interviews revealed that many visitors did not receive NPS brochures. Of those who did, some arrived at their backcountry destinations so late that lack of energy and daylight often prevented location of the cables, while others believed that their own methods (e.g., submerging food in nearby streams) were superior to those of the Park Service. Results

were often disastrous to vacations. Even some who stored food properly received damage to equipment by "closing" it after removing the contents; we as well as some NPS employees noted that bears rarely oriented toward empty water bottles with caps removed or backpacks with the zippers and flaps left open.

#### Aversive Conditioning

The management objectives of the National Park Service would be met if bear behavior ceased to be influenced by humans and their possessions. Approach to an improved relationship was attempted through aversive conditioning procedures.

#### Food Aversion

A taste aversion paradigm was tested at Boothe Lake and Little Yosemite Valley (LYV) campgrounds during August and September of 1978. Lithium chloride pellets were wrapped in parafilm and placed in hot dogs, a novel food used to test our ability to avert bears to a given item. No definite effect was documented. Few bears taking the baits were identified due to nocturnal habits, lack of marks, etc. Other problems included inability to predict the size of the bear that would take the bait and to get bears to take all of the LiCl pellets. The major difficulty, however, was the realization of the financial cost and improbability of treating all types of artificial food presented to bears at backcountry sites. Each bear would need to be averted to each item (see Revusky and Bedarf 1967).

#### Aversion Tests with Single Foodsacks

A method which could break the positive link between backcountry camper food and the most commonly related item, the foodsack, was sought (Hastings and Gilbert 1981). Conditioning was conducted during May and early June

of 1979 at Rancheria Falls. Initial tests documented bear response to a single aversion foodsack. A plastic bag with one liter of two percent ammonium hydroxide was placed in a counterbalanced foodsack 2.5 m above the ground. A string was left dangling from the foodsack for easy access by the bears. A balloon was also placed in the stuffsack for a two-fold purpose, that of providing a loud noise and of producing a full appearance to the sack. The foodsack was observed for approximately 12 hours per day from an overlooking post some 50 m away. Only one sack was in use at any given time during this experiment. Immediate responses of individual bears were recorded. The overall effectiveness was documented by interviewing campers each morning and recording the number of those camps which noted bear activity, interactions, and damages from the previous 24 hours at that location. The first 7 days following the introduction of the aversion sack were chosen as the treatment period; therefore, interview data collected during that period were neither used in pre-treatment nor post-treatment analysis.

The bears usually avoided touching the aversion sack and exposing its contents. However, the interview data indicated that this did not alter the normal food-obtaining activities of bears; there were no significant differences in bear activity, interactions, or damages after the aversion sack was used compared with the same measures before the treatment.

These results demonstrated a need for a major alteration in the methodology, including the simultaneous use of numerous aversion sacks with different storage techniques (e.g., hanging between two trees, hanging too close to the ground, etc.). Such changes could prevent the bears from becoming adapted to the experimental bags.

Aversion Tests with Multiple Foodsacks

This experiment was conducted in July, August, and September of 1979 at Beehive Meadows. A balloon was filled with one liter of 5 percent ammonium hydroxide and placed in the bottom of a stuffsack, daypack, or plastic bag. Ten holes (approx. 0.5 cm wide) were burned in the bottom of each foodsack for quick dispersion of the liquid. Numerous 5 cm-wide cardboard strips were placed in the sack above the balloon to provide a full appearance.

The containers were then placed in and around the campground using at least nine different colored sacks and ten different food storage methods. Each time that a solution was exposed, that particular sack was changed and a new one with a different color, but identical food storage method, was used. The five least contacted sacks were removed every seven days and replaced with sacks under different food storage conditions. The sacks were in use for 24 hours per day; therefore, not all encounters with stuff sacks were recorded.

Data were collected in the same manner as in the tests with single foodsacks, but interviews were also conducted at Laurel Lake Campground approximately 2.5 km away in order to document the effect on the nearest campground. The two sites have approximately the same elevation and the same type of vegetation.

Results show that the aversion sacks were often touched (43 percent of the time), but rarely with enough vigor to burst the balloons containing the ammonium hydroxide (13 percent). These responses suggest that the bears were not totally averted to the test sacks, but that they became cautious in their pursuit of those sacks.

The interview data showed a promising change in the bears' patterns.

Although there were no significant differences between Beehive (treated) and Laurel Lake (untreated) before conditioning, there were more bear activity and interactions at Laurel Lake than Beehive following the treatment, indicating a definite shift away from the treated site. Beehive received significantly less activity ( $p \leq .01$ ), interactions ( $p \leq .01$ ), and damages ( $p \leq .05$ ) following aversion, while there was also a significant decrease in activity at Laurel Lake. These results indicate a strong effect on the bears for the particular site of aversion and suggest a weaker, but still observable, effect on them for something else---perhaps foodsacks.

The possibility that these decreases were due to natural conditions is reduced by comparing the two sites for the same periods. Although there were no significant differences between Beehive (treated) and Laurel Lake (untreated) before the treatment period, there were significantly more bear activity and interactions at Laurel Lake than Beehive following the treatment. If natural conditions had caused the decreases at Beehive, then there should have been no differences between these similar areas following the treatment period.

These data indicate that this technique might be employed to pressure problem bears from one campground to another, and gradually out of the present status of being "problems". In consideration of this proposal, the alternatives that the researchers consider open to bear managers should be discussed.

The major options identified by the researchers are increased euthanization, increased regulation enforcement, and increased installation of bear cables, bear-proof PVC backpacker lockers, and/or bear-proof metal lockers. Euthanization involves problems similar to aversion with poor public relations and curing the symptom rather than the disease. Increased

regulation enforcement also has political implications, particularly when 92 percent of the backcountry users state that they store their food properly, while only 3 percent actually do adequately store their food (Cella and Keay 1980).

Increased installation of bear cables for hanging visitor foodsacks is a possibility, but the cables provide problems of their own. They are often difficult to find when not in use, provide a visual impact when heavily used, require maintenance, and are far from fool-proof.

Bear-proof food containers (either PVC or metal) may be applicable. Their advantages and disadvantages are discussed below.

#### Bear-Proof Food Containers

##### Metal Lockers

Twelve 122 cm x 46 cm x 46 cm metal boxes were placed in LYV Campground during July of 1979. Data on activity, interactions, and damages were collected in the same manner as in the foodsack aversion experiments from June through August except during installation.

The bear-proof lockers appeared to substantially decrease the bears' feeding activity at the treatment site (Table 11). The decreases occurred at approximately the same time that the lockers were installed and not after destruction of a yearling male during Week 4 (Figure 1).

The interpretation that this experiment was successful may be confounded by unknowns such as an increase in the availability of natural foods after the installation of the lockers. Nevertheless, the positive results from the assessment of the bear-proof lockers suggest that their installation was related to the reduction in bear problems and should be tested further. In particular, the effect of installation of food lockers

earlier in the season should be evaluated.

#### Portable PVC Cylinders

Two portable food containers constructed of PVC irrigation pipe and light-weight steel rods were evaluated for effectiveness of food protection in the backcountry during portions of August, September, and October of 1979. The first container was used 38 days at Rancheria Falls and the second was employed 66 days at Beehive Meadows and later Rancheria Falls (following the removal of the first box) for a total of 104 days for the two cylinders. The results of the testing demonstrate the potential of these devices (Table 12). The known effectiveness ( $100 - \frac{\text{successes} \times 100}{\text{known attempts}}$ ) for both containers was 96 percent. The actual effectiveness was probably higher since numerous attempts were probably made when the researchers were asleep or away from camp although any displacement of a container was only counted as a single attempt.

Eight bears were identified during 32 of the 45 known attempts and were almost entirely subadult males and adult females (Table 13). These bears, as well as one subadult female who was never recorded to have made an attempt, were the primary subjects in the two study areas.

Exact and estimated durations were recorded for 34 of the 45 attempts. The total contact time was approximately 167 minutes for a mean of 4 min. 51 sec./attempt.

The results of the study illustrate an excellent potential for use of the cylinders in backcountry bear management. Solutions of problems with lid removal, etc., are presently being sought by NPS personnel. A longer time frame for evaluation of these devices may be required as the learned behavior of problem bears would not be expected to extinguish quickly.

"Extent of the Problem" Study

Informal interviews with backcountry visitors were conducted each morning in order to obtain an estimate of the extent of the bear problem as well as to document the effect of aversive conditioning and metal food lockers. Data were collected for the previous 24-hour period and analyzed for all parties, organized groups ( $\geq 8$  people/party), and smaller groups ( $< 8$  people/party). Data collectors informed visitors at the conclusion of interviews that they (the visitors) had not officially reported their damage and that they should do so.

For all data combined from the entire park (Table 14), almost half (48.1%) of the camps each day noted some type of bear activity, 41.0% had interactions with bears, and 12.6% sustained some bear damage to equipment or food. Each backcountry party averaged about \$1.44 damage. These figures may be low since approximately two-thirds of the data were collected in LYV where bear problems were less frequent than other study areas, although LYV only received about 10 percent of the backcountry visitation during 1979 (NPS records).

Parkwide data (Table 15) which do not include that for LYV (Table 16), a heavily used site which almost always had at least one ranger on duty, illustrate an even larger problem with 63.9 percent of the parties noting bear activity, 60.5 percent with interactions, and about one-fourth sustaining damage. The bias is, of course, that data were usually collected in areas known for bear activity. Nevertheless, people tended to congregate in certain areas, and the Yosemite bears often tended to be wherever there were concentrations of backcountry people. Thus, these estimates may be relatively accurate although a future study of this problem should sample a more even

distribution of visitor use.

Large groups were more likely to receive bear activity, interactions, and especially damages (Tables 14-16). This is partially due to more people being available to interact and lose food to bears. However, organized groups (Boy Scout troops, etc.) rarely appeared to be truly "organized". These groups were infamous for storing food improperly on a regular basis (e.g., tying foodsacks to tree trunks, etc.).

It is imperative that resource managers realize the extent of bear damage in the backcountry. Therefore, data were again separated into areas with and without rangers and extrapolated for all of the parties at the time of interviews. In LYV, 27.9 percent of the estimated number of parties with damages were reported, although 51.6 percent of the estimated financial damage (in dollars) was reported. For other backcountry areas, only 1.3 percent of the number of damages estimated were reported while 2.8 percent of the financial damage was reported. Visitors appeared to be reluctant to report bear damage unless it was easy to do so. This unwillingness may have been accompanied by a fear of receiving a citation for improper food storage. However, these characteristics appeared to give way somewhat with more expensive damage as seen by the much higher percent of estimated dollar loss being reported. People who had large losses appeared to be more angry and more willing to risk a citation in the hopes of being reimbursed for their damage.

## MANAGEMENT RECOMMENDATIONS

Human-Bear Interactions

RECOMMENDATION I. Brochures should incorporate additional information and suggestions for visitor knowledge and behavior which deters bears:

1. Bears in Yosemite are American black bears (*Ursus americanus*) regardless of their actual color. The information in this brochure does not apply to the more aggressive grizzly bears (*Ursus arctos horribilis*) or Alaskan brown bears (*Ursus arctos middendorphii*), and perhaps not to black bears in other areas.
2. Throwing objects, yelling, clapping hands, and banging pots together can be effective in removing bears from a camp.
3. Combining the above actions can increase effectiveness.
4. These actions should be immediate, preventing the bear from getting too close, provided that it is not closer than about 17 feet (5m) when first discovered nor becomes that close during the interaction.
5. Bears should be frightened away before they reach camper food; otherwise they are much more difficult to remove.
6. Backcountry trips should not be attempted unless the hikers know that they will arrive at their destination long before dark.
7. Good flashlights with good batteries are a must.
8. Not only should flaps and pockets be left open on backpacks, but the tops of camping equipment such as water bottles should also be removed.

RATIONALE: Most visitors are not experienced enough with backpacking in black bear country to properly handle problems which may arise. The

above suggestions may help to prevent unnecessary losses of food and enjoyment.

RECOMMENDATION II. Information in brochures should not describe human behavior with the word "aggressive".

RATIONALE: People quickly skimming the brochure could easily misinterpret the meaning.

RECOMMENDATION III. A high-quality 16 mm movie on human-bear interactions and proper food storage in the backcountry should be produced. It should be shown at least in Yosemite Valley and Tuolumne Meadows at regular intervals. If it were to prove highly effective in reducing bear problems, then the Park Service could consider mandatory viewing by visitors before issuing wilderness permits.

RATIONALE: Watching a film would probably be much more interesting and easier to understand than reading about interactions and food storage.

RECOMMENDATION IV. Instructions should be provided on the specific location and use of bear-proof devices, either at the campsite or in a brochure (which includes a reduced map of the site) or both.

RATIONALE: Ignorance of the existence or location of lockers and food suspension cables defeats their purpose and leads to losing visitors' food as well as reinforcing approach by bears.

RECOMMENDATION V. All bear-proof devices should be maintained on a regular basis.

RATIONALE: Lockers filled with trash or cables lined with broken string/rope may reduce visitor use of those methods.

RECOMMENDATION VI. A kiosk should be located so as to monitor the Hetch Hetchy area.

RATIONALE: This would better insure that backcountry visitors in a relatively large portion of the park would have information pertaining to bears and other resources. It would also lead to a much more comprehensive monitoring of problems in that area from returning hikers.

RECOMMENDATION VII. The effectiveness of brochures and other techniques for distributing information about bears (e.g., personal contact, naturalist talks, etc.) should be evaluated.

RATIONALE: Improvements are obviously needed in educating people about bears. However, it is uncertain as to which techniques need alteration.

#### Aversive Conditioning

RECOMMENDATION VIII. Aversion of bears to foodsacks is a possibility for management practice. However, further study into its effectiveness, cost, and acceptance by the public is recommended.

RATIONALE: This technique has shown promising results, although the sample size would need to be increased. A cost/benefit analysis and evaluation of visitor reaction might determine its usefulness independent of its scientific potential.

#### Bear-Proof Food Containers

RECOMMENDATION IX. Metal food lockers should be installed in several backcountry campgrounds. They should be placed with a native stone facade in areas of the least problems with wilderness compliance

(e.g., at High Sierra Camps).

RATIONALE: Bear approaches to campgrounds can be reduced in frequency if food quantity and quality are significantly reduced.

RECOMMENDATION X. Portable food containers made of PVC irrigation pipe should be tested further.

RATIONALE: This method might prevent bears from obtaining food while abiding by wilderness standards and being inexpensive and easy to carry.

RECOMMENDATION XI. A pilot scale elimination of camper food for bears incorporating the following elements should be implemented:

1. Provide PVC containers and metal lockers for all food at the campsite. Promote tolerance by NPS staff of temporary lockers in backcountry campsites in order to test the effectiveness of the concept.
2. Test this procedure at an isolated backcountry campsite which has previously experienced significant numbers of bear-human interactions. Evaluation of the procedure for two summer months by bear management staff would seem appropriate.
3. Increase enforcement to a level to attain almost 100 percent concurrence from the public.
4. Monitor the frequency of bear-human interactions through summer interviews to provide data for comparison with former years and other campgrounds. The 1979 interview data provided by the Utah State University study would be suitable for this comparison.

RATIONALE: Present levels of food reinforcement appear adequate to maintain significant levels of bear-human interactions. Temporary

intensive management efforts to remove the availability of food are necessary to break the chain of learning that is occurring. Attempts along this line are already underway. It seems reasonable to expect that less extreme measures will suffice in the future when cubs are weaned onto natural food. This is consistent with the results of successful management activities introduced in Yellowstone National Park for black bears.

If this option is successful in a restricted geographic area then managers may wish to expand the procedure to another area in the following year as budgets and man-power permit. Emphasis on thorough assessment will be required to determine if the management phase attains the criterion level of success.

#### Extent of the Problem

RECOMMENDATION XII. Visitors should be told of the extent of the bear problem in Yosemite in percentages.

RATIONALE: Visitors may recognize that there really is a problem if brochures state that as many as 41% of the visitors in 1979 may have had interactions with bears.

RECOMMENDATION XIII. The size of organized groups allowed to hike in Yosemite should be reduced.

RATIONALE: Leaders might be better able to prevent bear problems with smaller groups. Accidents (e.g., falling off falls) might also be reduced.

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**APPENDIX**

Table 1. Rank, number, and percentage of each visitor response to bears.

Rank	Behavior	No. of Responses	Percent of Total Responses
1	Watch/listen	2033	34.6
2	Walk toward bear	645	11.0
3	Talk to others/point at bear	481	8.2
4	Photograph bear	348	5.9
5	Stop (neutral)	341	5.8
6	Walk away	300	5.1
7	Yell at bear	292	5.0
8	Throw objects	172	2.9
9	Travel	165	2.8
10	Gather belongings or put away food	114	1.9
11	Stand up	109	1.9
12	Combine aggression	109	1.9
13	Talk to bear	99	1.7
14	Bang objects together	94	1.6
15	Stop (fear)	81	1.4
16	Mill about	74	1.3
17	Run toward	64	1.1
18	Clap hands	52	.9
19	Whistle at bear	42	.7
20	Wave arms	39	.7
21	Shine flashlight at bear	34	.6
22	Make other loud nonverbal noise	33	.6

Table 1. Continued.

Rank	Behavior	No. of Responses	Percent of Total Responses
23	Sit down or crouch	30	.5
24	Miscellaneous neutrality	27	.5
25	Miscellaneous approach/aggression	24	.4
26	Run away	22	.4
27	Sit up	19	.3
28	Drop pack	6	.1
29	Turn off flashlight	6	.1
30	Hide	5	< .1
31	Miscellaneous fear/avoidance	5	< .1
32	Huff or grunt at bear	5	< .1
33	Lie down	3	< .1
34	Attempt to feed bear	3	< .1
35	Attempt to touch bear	1	< .1
36	Climb tree	0	< .1
		5,877	100.0

Table 2. Specific responses of visitors to specific behaviors of bears. Only behaviors of visitors with 10 percent or more of the responses and  $N \geq 1$ , or 20 percent or more and  $N = 1$  were included.

Bear Behavior	Visitor Response														
	Rank 1			Rank 2			Rank 3			Rank 4			Rank 5		
	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%
Climb tree (fear)	Watch	19	40.8												
Run away	Watch	117	34.2	Stop (neutral)	44	12.9	Walk toward bear	42	12.3						
Walk away	Watch	182	29.4	Walk toward bear	141	22.7									
Stop (fear)	Watch	94	38.7	Walk toward bear	32	13.2									
Climb down tree	Watch	18	34.0	Walk toward bear	6	11.3									
Non-aggr. vocalization	Watch	2	28.6												
Groom	Watch	20	33.9	Photograph	17	28.8	Talk/Point	6	10.2						
Feed or drink (nat.)	Watch	48	47.1	Talk/Point	15	14.7	Photograph	11	10.8						
Climb tree to feed	Watch	8	61.5												
Attempt to feed (nat.)	Watch	12	54.5	Walk toward bear	3	13.6									

Table 2. Continued.

		Bear Behavior										Visitor Response														
		Rank 1					Rank 2					Rank 3					Rank 4					Rank 5				
		Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%				
Travel	Watch	294	37.8	Walk toward bear	79	10.2																				
Watch	Watch	274	35.3																							
Sit down	Watch	29	49.2	Walk toward bear	9	15.3	Talk/Point	8	13.6																	
Lie down	Watch	8	42.1	Talk/Point	3	15.8	Mill about	2	10.5	Stop (Neut)	2	10.5														
Stand up	Watch	38	56.7	Talk/Point	7	10.4																				
Mill about	Watch	136	38.3	Talk/Point	45	12.7	Walk toward bear	38	10.7																	
Attempt to feed (art.)	Watch	154	33.9	Talk/Point	47	10.4	Yell at bear	47	10.4	Walk toward bear	46	10.1														
Feed (art.)	Watch	112	27.5	Talk/Point	61	10.4																				
Walk toward	Watch	194	23.8	Walk away	86	10.6																				
Grunt	Watch	2	100.0																							
Huff	Watch	5	38.5	Walk away	2	15.4																				

Table 2 . Continued.

Bear Behavior	Visitor Response														
	Rank 1			Rank 2			Rank 3			Rank 4			Rank 5		
	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%
Pop jaw	Drop pack	1	100.0												
Other aggr. vocalization	Watch	1	50.0	Photograph bear	1	50.0									
Slap ground/ object	Run away	1	33.3	Stop (fear)	1	33.3	Yell at bear	1	33.3						
Circle person	Watch	3	30.0	Talk/Point	2	20.0	Yell at bear	2	20.0						
Jump toward	Walk away	8	36.8	Talk/Point	3	15.8	Travel	2	10.5	Yell at bear	2	10.5	Throw objects	2	10.5
Run toward	Run away	7	25.0	Walk away	7	25.0	Stop (fear)	3	10.7	Watch	3	10.7	Yell at bear	3	10.7
Injure	Never occurred														
Other	Never occurred														
Stop (neutral)	Watch	203	48.6	Walk toward	43	10.3									
Run away w/ food or container	Walk toward bear	10	23.3	Watch	9	21.0	Run toward	6	14.0						

Table 3. Rank, number, and percentage of each bear response to visitors.

Rank	Behavior	No. of Responses	Percent of
			Total Responses
1	Walk away	822	14.2
2	Watch	778	13.5
3	Travel	725	12.5
4	Walk toward	564	9.8
5	Run away	477	8.2
6	Stop (neutral)	422	7.3
7	Attempt to feed (artificially)	410	7.1
8	Feed (artificially)	394	6.8
9	Mill about	296	5.1
10	Stop (fear)	242	4.2
11	Feed/drink (naturally)	98	1.7
12	Stand up	67	1.2
13	Miscellaneous neutrality	66	1.1
14	Groom	58	1.0
15	Sit down	56	1.0
16	Climb tree (fear)	54	.9
17	Climb down tree	51	.9
18	Run away w/ food or container	49	.8
19	Attempt to feed (naturally)	22	.4
20	Run toward	22	.4
21	Lie down	20	.3
22	Miscellaneous fear/avoidance	18	.3

Table 3. Continued.

Rank	Behavior	No. of Responses	Percent of Total Responses
23	Jump toward	14	.2
24	Huff	13	.2
25	Climb tree to feed	11	.2
26	Circle person	10	.2
27	Non-aggressive vocalization	7	.1
28	Walk away w/ food or container	7	.1
29	Slap ground/object	3	< .1
30	Miscellaneous approach/aggression	3	< .1
31	Grunt	2	< .1
32	Other aggressive vocalization	2	< .1
33	Pop jaw	1	< .1
34	Injure	0	0.0
		5784	100.0

Table 4. Specific responses of bears to specific behaviors of visitors. Only behaviors of bears with 10 percent or more of the responses and  $N > 1$ , or 20 percent or more and  $N = 1$  were included.

Human Behavior	Bear Response														
	Rank 1			Rank 2			Rank 3			Rank 4			Rank 5		
	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%
Climb tree (fear)	Never occurred														
Run away	Walk toward	3	23.1	Att. to feed art.	2	15.4	Feed art.	2	15.4	Run toward	2	15.4			
Walk away	Walk toward	38	17.9	Att. to feed art.	29	13.7	Walk away	27	12.7	Travel	27	12.7			
Stop (fear)	Watch	26	32.1												
Drop pack	Watch	1	50.0	Walk toward	1	50.0									
Hide	Walk away	1	20.0	Travel	1	20.0	Stand up	1	20.0	Att. to feed art.	1	20.0	Misc. Neut.	1	20.0
Talk to bear	Travel	18	18.0	Walk toward	15	15.0	Watch	14	14.0	Walk away	11	11.0			
Sit down or crouch	Feed art.	6	22.2	Watch	5	18.5	Travel	4	14.8	Walk toward	4	14.8			
Gather belongings or put away food	Walk toward	21	18.9	Watch	20	18.0	Travel	17	15.3	Walk away	15	13.5			
Talk/Point	Travel	64	13.4	Feed art.	61	12.8	Watch	56	11.7	Walk away	53	11.1			
Travel	Watch	36	21.3	Travel	33	19.5	Feed art.	20	11.8						

Table 4 • Continued.

Human Behavior	Bear Response														
	Rank 1			Rank 2			Rank 3			Rank 4			Rank 5		
	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%
Watch/listen	Travel	282	14.5	Watch	245	12.6	Walk away	239	12.3	Walk toward	209	10.8			
Sit up	Run away	3	15.0	Travel	3	15.0	Watch	3	15.0	Mill about	3	15.0			
Lie down	Att. to feed art.	1	50.0	Walk toward	1	50.0									
Stand up	Walk toward	36	31.0	Travel	13	11.2									
Mill about	Watch	23	29.4	Stop (neut.)	13	16.5	Travel	9	11.4	Walk toward	9	11.4			
Att. to feed bear	Feed art.	1	33.3	Stop (neut.)	1	33.3	Run away w/ food container	1	33.3						
Shine flashlight at bear	Walk away	14	42.4	Att. to feed art.	5	15.2									
Walk toward bear	Walk away	156	21.4	Watch	110	15.1									
Attempt to touch bear	Att. to feed art.	1	100.0												
Wave arms	Run away	8	20.5	Watch	7	17.9	Stop (fear)	6	15.4	Walk away	5	12.8			
Make other loud nonverbal noise	Watch	7	20.6	Run away	5	14.7	Stop (fear)	4	11.8	Travel	4	11.8			

Table 4. Continued.

Human Behavior	Bear Response														
	Rank 1			Rank 2			Rank 3			Rank 4			Rank 5		
	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%
Clap hands	Walk away	9	17.3	Run away	8	15.4	Stop (fear)	8	15.4						
Whistle at bear	Run away	7	16.7	Walk away	7	16.7	Feed art.	7	16.7	Travel	6	14.3			
Bang objects together	Walk away	23	25.0	Watch	21	22.8	Run away	12	13.0	Travel	10	10.9			
Yell at bear	Run away	80	26.8	Walk away	46	15.4	Walk toward	30	10.0						
Run toward	Run away	30	43.5	Walk away	8	11.6									
Throw objects	Run away	88	51.2	Walk away	27	15.7									
Other	Never occurred														
Stop (neutral)	Travel	64	18.9	Walk away	49	14.5	Watch	45	13.3	Stop (neut.)	35	10.4			
Combine aggr.	Run away	48	43.2	Walk away	16	14.4									
Turn off flashlight	Travel	1	33.3	Lie down	1	33.3	Misc. neut.	1	33.3						
Misc. avoid/fear	Walk away	2	40.0	Stop (fear)	1	20.0	Walk toward	1	20.0	Run toward	1	20.0			
Photograph bear	Walk away	67	18.9	Watch	55	15.5	Travel	48	13.6						
Misc. neutrality	Watch	8	29.6	Walk toward	5	18.5									

Table 4. Continued.

Human Behavior	Bear Response														
	Rank 1			Rank 2			Rank 3			Rank 4			Rank 5		
	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%	Behavior	N	%
Huff or grunt at bear	Stop (fear)	2	40.0	Climb tree (fear)	1	20.0	Climb down tree	1	20.0	Walk toward	1	20.0			
Misc. approach/ aggression	Run away	8	33.3	Travel	6	25.0	Walk away	4	16.7						

Table 5. Visitor behaviors grouped into each class.

Fear/Avoidance	Neutrality	Approach	Aggression
Climb tree	Talk to bear	Walk toward bear	Shine flashlight at bear
Run away	Sit down or crouch	Attempt to touch bear	Wave arms
Walk away	Gather belongings or put away food		Make other loud nonverbal noise
Stop (fear)			
Drop pack	Talk to others or point at bears		Clap hands
Hide	Travel		Whistle at bear
Turn off flashlight	Watch/listen		Bang objects together
Misc. fear/avoidance	Sit up		Yell at bear
	Lie Down		Run toward bear
	Stand up		Throw objects
	Mill about		Combine aggression
	Attempt to feed bear		Huff or grunt at bear
	Stop (neutral)		Misc. aggression
	Photograph bear		
	Misc. Neutrality		

Table 6. Bear behaviors grouped into each class.

Fear/Avoidance	Neutrality	Approach	Aggression
Climb tree (fear)	Climb down tree	Walk toward	Grunt
Run away	Non-aggressive vocalization		Huff
Walk away	Groom		Pop jaw
Stop (fear)	Feed or drink (naturally)		Other aggressive vocalization
Run away w/ food or container	Climb tree to feed		Slap ground or object
Walk away w/ food or container	Attempt to feed (naturally)		Circle person
Misc. fear/ avoidance	Travel		Jump toward
	Watch		Run toward
	Sit down		Injure
	Lie down		Misc. aggression
	Stand up		
	Mill about		
	Attempt to feed (artificially)		
	Feed (artificially)		
	Stop (neutral)		
	Misc. neutrality		

Table 7. Number and percentage of classes of visitor responses to bears.

Class	No. of Responses	Percent of Total Responses
Fear	425	7.2
Neutrality	3846	65.4
Approach	646	11.0
Aggression	960	<u>16.3</u>
	5877	100

Table 8. Classes of visitor responses to classes of bear behaviors.

(Row percentages are given in parentheses.)

Bear Behavior	Visitor Response				Total
	Fear	Neutrality	Approach	Aggression	
Fear	78 (5.9)	749 (56.6)	230 (17.4)	266 (20.1)	1323
Neutrality	209 (5.7)	2602 (71.1)	361 (9.9)	486 (13.3)	3658
Approach	107 (13.1)	464 (56.9)	52 (6.4)	192 (23.6)	815
Aggression	31 (38.3)	31 (38.3)	3 (3.7)	16 (19.7)	81
	425 (7.2)	3846 (65.4)	646 (11.0)	960 (16.3)	5877

Table 9. Number and percentage of classes of bear responses to visitors.

Class	No. of	Percent of
	Responses	Total Responses
Fear	1669	28.9
Neutrality	3481	60.2
Approach	564	9.8
Aggression	<u>70</u>	<u>1.2</u>
	5784	100.0

Table 10. Classes of ursid responses to classes of visitor behaviors.

(Row percentages are given in parentheses.)

Visitor Behavior	Bear Response				Total
	Fear	Neutrality	Approach	Aggression	
Fear	63 (19.6)	201 (62.6)	48 (15.0)	9 (2.8)	321
Neutrality	722 (19.2)	2572 (68.4)	421 (11.2)	47 (1.2)	3762
Approach	293 (40.2)	391 (53.6)	38 (5.2)	7 (1.0)	729
Aggression	591 (60.8)	317 (32.6)	57 (5.9)	7 (0.7)	972
	1669 (28.9)	3481 (60.2)	564 (9.8)	70 (1.2)	5784

Table 11. Summary of the interview data before and after the introduction  
of the metal food lockers (Little Yosemite Valley).

Number of Camps:	Pre-treatment	Post-treatment
Interviewed	592	448
With activity	313	92
With interactions	253	55
With damages	49	13

Table 12. Summary of effectiveness of portable food containers.

Category	Container Number		Total
	1	2	
Days in operation	38	66	104
Known attempts	30	15	45
No. of times damaged	1	0	1
Successes of bears in obtaining food	1	0	1
Effectiveness	96.7%	100.0%	97.8%

Table 13. Number of attempts and non-attempts (i.e., times where bears approached within 10 m of containers but did not attempt to open them) for known bears.

Bear #	Age/Sex Class	# of Attempts	# of Non-attempts
Cub of 834	Cub *	1	0
831	Subadult ♀	0	1
274	Subadult ♂	5	0
273	Subadult ♂	12	2
829	Adult ♀	1	0
444	Adult ♀	2	0
269	Adult ♀	2	3
834	Adult ♀	4	0
267	Adult ♀	5	0
		—	—
		32	6

\*Sex was undetermined

Table 14. Summary of interviews for all sites studied.

Number of Camps:	No. of Camps	% of Camps	No. of Camps	% of Camps	Total	% of Camps
	with < 8 Visitors	Interviewed	with $\geq$ 8 Visitors	Interviewed	Interviewed	
At sites interviewed	1736	-	105	-	1841	-
Interviewed	1546	100.0	101	100.0	1647	100.0
With activity	725	46.9	66	67.3	793	48.1
With interactions	611	39.5	64	63.4	675	41.0
With damages	171	11.1	37	36.6	208	12.6
Damage estimates	\$1093	\$1.22	\$483	\$4.78	\$2376	\$1.44

Table 15. Summary of interviews for all sites studied except Little Yosemite Valley.

Number of Camps:	No. of Camps with < 8 Visitors	% of Camps Interviewed	No. of Camps with $\geq$ 8 Visitors	% of Camps Interviewed	Total	% of Camps Interviewed
At sites interviewed	634	-	48	-	682	-
Interviewed	560	100.0	47	100.0	607	100.0
With activity	348	62.1	40	85.1	388	63.7
With interactions	328	58.6	37	83.0	367	60.5
With damages	118	21.1	28	59.6	146	24.1
Damage estimates	\$1538	\$2.75	\$402	\$8.55	\$1940	\$3.20

Table 16. Summary of interviews for Little Yosemite Valley.

Number of Camps:	No. of Camps	% of Camps	No. of Camps	% of Camps	Total	% of Camps
	with < 8 Visitors	Interviewed	with $\geq$ 8 Visitors	Interviewed		Interviewed
At sites interviewed	1102	-	57	-	1159	-
Interviewed	986	100.0	54	100.0	1040	100.0
With activity	377	38.2	28	51.9	405	38.2
With interactions	283	28.7	25	46.3	308	29.6
With damages	53	5.4	9	16.7	62	6.0
Damage estimates	\$355	\$0.36	\$81	\$1.50	\$436	\$0.42

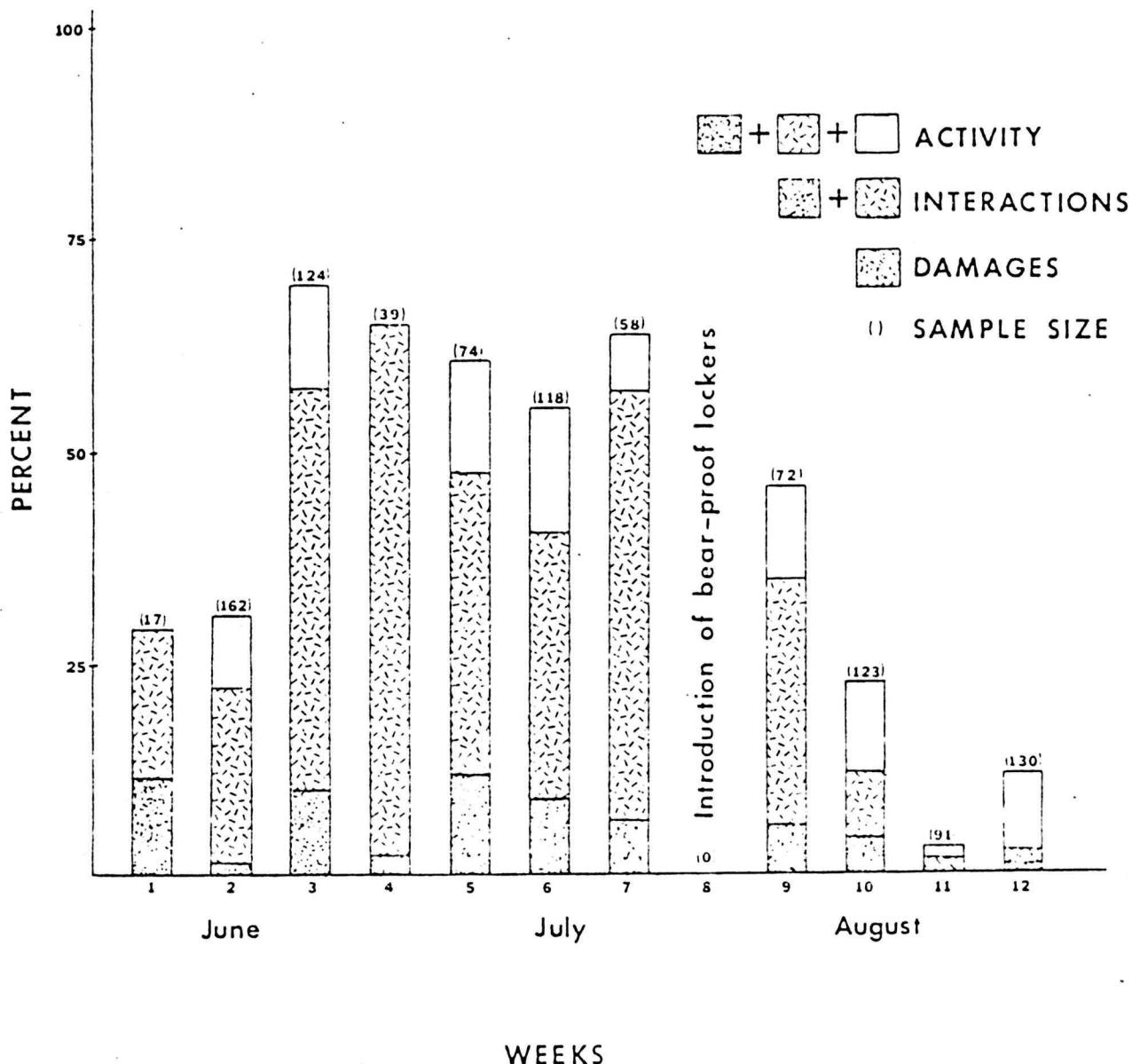


Figure 1. Weekly bear activity, interactions, and damages before and after the introduction of bear-proof metal foodlockers (Little Yosemite Valley).